A DAILY TAG RETURN MODEL FOR LOBSTER FISHERIES

by

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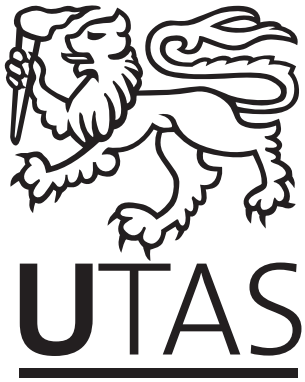

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Statement of Co-Authorship

The following people and institutions contributed to the publication of the work undertaken as part of this thesis (Chapter 7):

A modelled cost-benefit analysis of hybrid PIT and conventional tagging scenarios, *New Zealand Journal of Marine and Freshwater Research*, 2009, Vol 43, 339–346.

Paul Burch (Candidate 70%), Stewart Frusher (15%), Simon Wotherspoon (10%), Tom Polacheck (5%).

Details of the Authors roles:

Stewart Frusher assisted with the development of the study and refinement of the manuscript, Simon Wotherspoon assisted with implementation of the model and refinement of the manuscript, Tom Polacheck assisted with refinement of the manuscript.

We the undersigned agree with the above stated "proportion of work undertaken" for the above published peer-reviewed manuscript contributing to this thesis:

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ABSTRACT

A daily tag return model was developed to estimate fishing and natural mortality, tag reporting rate and catchability with application to lobster fisheries. Tag return data is usually collected with knowledge of the exact date of recapture. By modelling tags individually, each tag contributes information on fishing and natural mortality, catchability and tag reporting rate to the likelihood. Providing sufficient tags are maintained in the fishery to enable recaptures to occur during the fishing season, finer resolution of parameters is possible.

Model performance was tested by simulation of different times of release and recapture as well as a range of different seasonal fishing patterns typically found in lobster fisheries. Precision and accuracy of estimates were improved when there was a contrast in fishing effort throughout the season or a seasonal closure within the year. The timing of tag release was not found to affect model performance.

Evaluation of the model was undertaken by comparison of estimates from a previous study using an identical dataset. Total mortality estimates were equivalent between models although separation of fishing and natural mortality differed between models. Small improvements in the precision of estimates were obtained for the model that incorporated exact times of tag release and recapture.

The daily model enabled finer time scale estimates of parameters and this was explored in the estimate of within season catchability. Penalised spline smoothing was applied to estimate catchability, resulting in a curve that captured the timing of biological events such as moulting and mating.

Higher fishing mortality estimates were obtained when the fishing fleet was separated into groups based on their reliability at returning tags. This suggests that fishing mortality estimates could be compromised when reporting rate is considered cosmopolitan across the entire fleet. However, the small number of reliable fishers and their fishing patterns, make interpretation of results problematic.

A cost-benefit analysis of the use of PIT tags compared to T-bar tags, the standard tag used in lobster fisheries, was undertaken. For a given cost the higher expenses associated with PIT tags and scanners resulted in fewer lobster being tagged compared to T-bar tags. The improved tag reporting rate from PIT tags resulted in improved precision and accuracy of mortality estimates using this technology unless the tag reporting rate for T-bar tags was substantially increased.

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